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(54) **HORIZONTAL SEAT POSITION ADJUSTER**

EINRICHTUNG ZUM VERSTELLEN DER HORIZONTALEN SITZPOSITION

MECANISME DE REGLAGE DE LA POSITION HORIZONTALE D'UN SIEGE DE VEHICULE

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Description

FIELD OF THE INVENTION

The present invention relates generally to seat adjusters of the type commonly used in motor vehicles and, more particularly, to a low vertical profile horizontal seat position adjustment mechanism of the kind as defined in the preamble of claim 1.

DESCRIPTION OF RELATED ART

The automotive vehicle designer seeks to achieve an aerodynamic profile to satisfy fuel consumption goals as well as to provide an aesthetically appealing appearance. A low roof line is essential to achieving an aerodynamic profile. A vehicle having a low roof line must also provide adequate head room for a vehicle occupant. Therefore, a low vertical profile seat must be utilized. The vertical profile of a seat is dictated by the height of the mechanism which provides vertical as well as fore-aft positional adjustment. Conventional technology such as described in US-A-3,182,947 and US-A-4,509,382 feature telescoping devices which include telescoping segments, which present an objectionably tall profile when adjusted to minimum vertical height position.

An additional problem encountered in seeking a seat design offering a minimum vertical profile is presented by mechanisms seeking to achieve fore-aft positioning of a vehicle seat. Such mechanisms present an overall height which is an accumulation of the individual heights of the transmission and the tracks. For example, in US-A-4,805,866, the transmission is located above and coaxial with the tracks. Therefore, the minimum profile defined by a seat adjusted to minimum vertical elevation is restricted by the height of the transmission protruding above the tracks themselves. Alternatively, the transmission may be located within the track. Such an implementation, however, requires an enlarged track cross section which significantly adds to the height thereof. The minimum profile defined by a seat adjusted to minimum vertical elevation is restricted by the height of the enlarged track. Such a design is characterized also in EP-A-O 277 069 illustrating a seat position adjustment mechanism in which the track members are dimensioned to permit location of a transmission (gear 20 and pinion 21) within the cross section of the interfitting tracks. To provide room to accommodate the transmission increases all cross sectional dimensions including the vertical height of the track members. Therefore, there is a need to provide track members having a transmission located at least partially within the tracks such that the track's dimensions need not accommodate the transmission.

SUMMARY OF THE PRESENT INVENTION

It is the object of the invention to provide a low vertical profile horizontal seat position adjustement mechanism which is so constructed that the minimum profile defined by a seat adjusted to minimum vertical elevation is not restricted by an enlarged vertical height of the track members nor by the vertical height of the transmission.

In order to achieve this object according to the invention, a low vertical profile horizontal seat position adjustement mechanism of the kind defined in the preamble of claim 1 is characterized in that the transmission is partially disposed within the open channel section formed between the track members, and the means to drivingly interconnect the helical gear and the screw is a flexible cable.

The present invention incorporates a mechanism used to control the fore-aft position of a vehicle seat while presenting a minimum height profile when adjusted to minimum vertical elevation. The seat is connected to a pair of rails, one stationary and one reciprocable. A seat is affixed to an attachment bracket which is connected to the reciprocable rail by a vertical height adjuster. The fore-aft relationship of the rails may be selectively adjusted by a motor driving a horizontally oriented screw jack. The screw jack incorporates a screw connected to a helical gear engaged to a worm gear. The worm gear is driven by a remote motor through a flexible drive cable. The screw jack presents a structure which offers a minimum height profile when the seat is positioned at minimum vertical height. In this manner, an aerodynamically efficient roof line may be utilized while providing maximum head room for the vehicle occupants.

The preferred embodiment of the present invention features a low vertical profile horizontal seat position adjustment mechanism to be used to provide selectable horizontal position adjustment of a vehicle seat with respect to a base which includes a pair of relatively reciprocable track members slidably interfitted with one another to form an open channel section therebetween. A first track of the pair is maintained fixed and the second track of the pair is reciprocable with respect thereto. A horizontally oriented rotatable screw is bearingly supported at opposing ends thereof to the second track and located within the open channel section defined by the interfitted track members. The screw is threadably engaged to a nut which is secured to the first track. A transmission partially located within the open channel formed by the interfitting track members includes a first housing defining a first half bore and a second half bore disposed orthogonal to said first half bore. The first housing is structurally interfitted to a second housing so as to define a cavity therebetween. The second housing defines a first half and a second half bore which interact with respective first and second half bores of said first housing to form first and second bores. The first and second bores define axes which are radially displaced and orthogonally oriented with respect to one another. Additionally, the second housing includes a radially extending portion which is located about the bore axially

displaced from and coaxial to the first bore thereby forming a first annular face. A helical gear is located within the cavity defined between the first and second housing. The gear includes a first diameter axially extending circumferential portion including teeth formed therein, in addition to a pair of opposed smaller diameter axially extending circumferential portions which define respective bearing surfaces. The second smaller diameter bearing surfaces of the helical gear are respectively disposed in a first bore and the bore axially displaced from and coaxial to the first bore to provide radial bearing support for the helical gear. The gear includes a radially extending surface defining a second annular face located between the respective first and second diameter portions of the helical gear which act in conjunction with the first annular face to provide an axial bearing support for the helical gear. A worm gear having first and second opposed end portions forming cylindrical coaxial bearing surfaces and an intermediate portion having a worm thread formed therein is maintained in alignment by the second bore to provide engagement with the helical gear. Fastener means are included to maintain the structural interfitting relationship between the first and second housing and secure the respective housings to the second track. Finally, means such as a flexible cable are provided to drivingly connect the helical gear of the transmission to the screw. Additionally, the nut engaged with the screw is fixed to the first track by means of a structural interfitting relationship therebetween.

These and other aspects of the present invention will become more readily apparent by reference to the following detailed description of the embodiments as shown in the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of the entire seat position adjuster;

Figure 2 is a cross-sectional view taken at line 2-2 of Figure 1;

Figure 3 is a cross-section of the vertical seat position adjuster;

Figure 4 is an exploded view of the vertical seat position adjuster;

Figure 5 is a cross-section of the horizontal seat position adjuster;

Figure 6 is an exploded view of the horizontal seal position adjuster;

Figure 7 is a side-view of the vertical seat position adjuster nut;

Figure 8 is a view of the vertical seat position adjuster nut; and

Figure 9 is a cross-section of the modular vertical and horizontal seat position adjuster.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention, as shown in Figures 1 through 9 is utilized in conjunction with an adjustably mounted automotive vehicle passenger seat 10 located within the passenger compartment of a vehicle upon floor pan 12. The seat adjuster mechanism 14 includes elongated channels or track members 16, 18 slidably interfitted to form an open channel section 101, an upper one or second track being designated as 16, and a lower one or first track designated as 18. Lower seat channel 18 is maintained stationary by mounting brackets 20, 20 connected to floor pan 12. Seat adjuster mechanism 14 further includes seat attachment bracket 22 and lateral interconnecting link 24. Vertical height adjusters 28, 28 are located at each of the four corners of seat 10. Vertical height adjusters 28 are utilized to control the elevation of seat 10. Vertical height adjusters 28, as shown in Figure 3 and 4, include a housing 30 which may be affixed to upper seat channel 16 by fasteners 32, 32. A worm gear 34 carried by spherical bearings 66, 66 is utilized to drive helical gear 36 to accomplish rotation of screw 38. As may be seen in Figure 8, nut 40 is retained in seat attachment bracket 22 and prevented from rotation about axis 56 of screw 38 by the structural interrelationship between side portions 52, 52 and seat attachment bracket 22. Housing base plate 42 structurally fits within housing 30 to define a cavity therebetween. Bores 58 and 62 interact with respective surfaces 58A and 62A contiguous with helical gear 36 to facilitate proper radial alignment of screw 38 upon rotation thereof. Axial loading transmitted into screw 38 is imparted through helical gear 36 into annular surface 60 of housing base plate 42. Hardened steel balls 46, 46, positioned within bore 64 defined in helical gear 36, facilitate a low resistance rotational bearing for vertical height adjuster 28. Beveled washer 48 provides an axial compliance to the assembly to maintain a compliantly rigid assembly. Nut 40, as shown in Figure 7 and 8, is contained within seat attachment bracket 22 and maintains contact therewith at four locations; fulcrum points 50, 50 as well as sides 52, 52. The structural interrelationship of seat attachment bracket 22 and nut 40 is such that nut 40 will be retained in seat attachment bracket 22 in such a manner that it may rotate about axis 54 while maintaining continuous contact at points 50, 50 with seat attachment bracket 22. In addition, nut 40 will be restrained from rotation about axis 56 by structural interference between portions 52, 52 and seat attachment bracket 22. In this manner any rotation of screw 38 will result in a change in vertical height of seat 10.

As shown in Figures 1, 5 and 6, the horizontal position of seat 10 is controlled by translating upper seat channel 16 with respect to lower seat channel 18 by rotating screw 100 while maintaining drive nut 102 stationary. Retention tabs 104, 104 define a fore-aft stationary position for nut 102 whereas the structural

interrelationship between lower seat channel 18 and nut 102 prevent rotation of nut 102 about the axis of screw 100. As shown in Figure 5, motor 106 drives a first flexible cable 108 which causes worm gear 110 engaged with helical gear 112 to rotate. Helical gear 112 as shown includes a first diameter axially extending circumferential portion having gear teeth formed thereon as well as opposed trunnion like smaller diameter axially extending circumferential portions defining bearing surfaces. Worm gear 110 engaged with helical gear 112 cause a transmission of rotary motion both in angle of axis as well as respective relative rates of rotation known to one skilled in the art as a transmission 111. Worm gear 110 is carried by two spherical bearings 120 in cavity 121 defined in housing 122. Worm gear 110 has end portions forming cylindrical coaxial bearing surfaces and an intermediate portion having a worm thread formed thereon. Housing 122 defines recesses 124, 124 and half-bores 99, 126 wherein half-bore 99 is disposed orthogonal to half bore 126 which cooperate with respective recesses defined in housing closure cap 128 to facilitate bearing support and engagement between helical gear 112 and worm gear 110. Housing 122 and 128 interfit to form orthogonally disposed bores and provide a cavity suitable for receipt of helical gear 112 and worm gear 110. Housing 122 and 128 may be secured together by known techniques such as heat welding or gluing. The assembly thereof may be secured to track 16 by fasteners. Flexible cable 114 transmits rotary motion to drivingly connect helical gear 112 to screw 100 causing same to rotate about stationary nut 102 producing a translation of screw 100. Upper seat channel 16 is connected to screw 100 at opposing ends through bearings 116, 116 which engage brackets 118, 118 connected thereto. In this manner, remotely located motor 106 may produce fore-aft translation of seat 10 to provide selectively adjustable position thereof. Jack housing 30 and housing 122 may be structurally interconnected, as shown in Figure 9, to provide a modular assembly that presents a consolidation of mounting tabs and associated fasteners requiring minimal package space and substantial weight savings.

One skilled in the art will readily recognize that certain specific details shown in the foregoing specification and drawings are exemplary in nature and subject to modification without departing from the teachings of the disclosure. Various modifications of the invention discussed in the foregoing description will become apparent to those skilled in the art. All such variations that basically rely on the teachings through which the invention has advanced the art are properly considered within the spirit and scope of the invention as defined in the appended claims.

Claims

1. A low vertical profile horizontal seat position adjustment mechanism to be used to provide selectable horizontal position adjustment of a vehicle seat (10) with respect to a base (12) comprising:

   a pair of relatively reciprocable track members (16, 18) slidably interfitted with one another to form an open channel section (101) therebetween;

   a first track (18) of said pair maintained fixed and a second track (16) of said pair reciprocable with respect thereto;

   a horizontally oriented rotatable screw (100) bearingly supported at opposing ends by said second track (16) and disposed within said open channel section (101);

   said screw (100) threadably engaging a nut (102) affixed to said first track (18);

   a transmission (111) including a housing (122, 128) defining a cavity (121);

   a helical gear (112) disposed within said housing (122, 128);

   a worm gear (110) disposed within said cavity and meshingly engaged to said helical gear (112); and

   means (114) to drivingly connect said helical gear (112) to said screw (100);

   characterized in that

   said transmission (111) is partially disposed within said open channel section (101) formed between said track members (16, 18) and

   said means to drivingly interconnect said helical gear (112) and said screw (100) is a flexible cable (114).

2. The low vertical profile horizontal seat position adjustment mechanism of claim 1, characterized by:

   said base being formed by a floor pan (12);

   said housing (122, 128) of said transmission (111) comprising a first housing (122) defining a first half bore and a second half bore disposed orthogonal to said first half bore, and a second housing (128) having a structural interfitting relationship with said first housing (122) defining said cavity (121) therebetween;

   said second housing (128) defining a first half and a second half bore which interact with respective first and second half bores of said

first housing (122) to form first and second bores;

said first and second bores defining axes which are radially displaced and orthogonally oriented with respect to one another;

said helical gear (112) being disposed within said cavity (121) defined between said first (122) and second housing (128);

said helical gear (112) including a first diameter axially extending circumferential portion including teeth formed therein;

said helical gear (112) including opposed second smaller diameter axially extending circumferential portions defining respective bearing surfaces;

said second smaller diameter bearing surfaces of said helical gear (112) being respectively disposed in said first bore and said bore axially displaced from and coaxial to said first bore to provide raidal bearing support for said helical gear (112);

said helical gear (112) including a radially extending surface defining a second annular face disposed between repsective first and second diameter portions of said helical gear (112) acting in conjunction with said first annular face to provide an axial bearing support for said helical gear (112);

said worm gear (110) having first and second opposed end portions forming cylindrical coaxial bearing surfaces and an intermediate portion having a worm thread formed therein;

said first and second portions being bearingly carried in said second bore to provide alignment of said worm thread with said teeth of said helical gear (112); and

means to maintain said structurally interfitting relationship between said first (122) and second housing (128) and secure said first housing (122) to said second track (16).

3. The low vertical profile horizontal seat position adjustment mechanism of claim 1 or 2, characterized in that said nut (102) is affixed to said first track (18) by means of a structural interfitting relation between said nut (102) and said first track (18).

4. The low vertical profile horizontal seat position adjustment mechanism of claim 1 or 2, characterized in that said worm gear (110) having first and second opposed end portions forming cylindrical coaxial bearing surfaces is carried by spherical bearing members (120) in said second bore.

Patentansprüche

1. Vorrichtung mit niedrigem vertikalen Profil zum Einstellen der horizontalen Sitzposition, die zum wählbaren Einstellen der horizontalen Position eines Fahrzeugsitzes (10) bezüglich einer Basis (12) verwendet wird, enthaltend:

zwei relativ zueinander hin- und herbewegbare Führungselemente (16, 18), die verschiebbar zusammengehalten werden, um zwischen sich ein U-Profil (101) zu bilden;

wobei ein erstes Führungselement (18) der beiden stationär gehalten und ein zweites Führungselement (16) der beiden demgegenüber hin- und herbewegbar ist;

eine horizontal ausgerichtete, drehbare Schraube (100), die an entgegengesetzten Enden durch das zweite Führungselement (16) gelagert und in dem U-Profil (101) angeordnet ist;

wobei die Schraube (100) in eine an dem ersten Führungselement (18) befestigte Mutter (102) eingedreht ist;

ein Getriebe (111) mit einem, einen Hohlraum (121) bildenden Gehäuse (122, 128);

ein in dem Gehäuse (122, 128) angeordnetes Schraubenrad (112);

ein in dem Hohlraum und mit dem Schraubenrad (112) kämmendes Schneckenrad (110); und

eine Einrichtung (114) zum triebschlüssigen Verbinden des Schraubenrads (112) mit der Schraube (100);

dadurch gekennzeichnet, daß

das Getriebe (111) teilweise in dem zwischen den Führungselementen (16, 18) gebildeten U-Profil (101) angeordnet ist und

die Einrichtung zum triebschlüssigen Verbinden des Schraubenrads (112) mit der Schraube (100) ein flexibles Kabel (114) ist.

2. Vorrichtung mit niedrigem vertikalen Profil zum Einstellen der horizontalen Sitzposition nach Anspruch 1, dadurch gekennzeichnet, daß

die Basis durch eine ebene Pfanne (12) gebildet ist;

das Gehäuse (122, 128) des Getriebes (111) ein erstes Gehäuse (122), welches eine erste Halbbohrung und eine zweite, zur ersten Halbbohrung rechtwinkelig angeordnete Halbbohrung definiert, sowie ein zweites Gehäuse (128) umfaßt, das mit dem ersten Gehäuse (122) baulich zusammengehalten ist, um dazwischen den Hohlraum (121) zu bilden;

das zweite Gehäuse (128) eine erste Halb- und eine zweite Halbbohrung definiert, die mit entsprechenden ersten und zweiten Halbbohrungen des ersten Gehäuses (122) zusammenwirken, um erste und zweite Bohrungen zu bilden;

die erste und zweite Bohrung Achsen festlegen, die radial versetzt und rechtwinkelig zueinander angeordnet sind;

das Schraubenrad (112) in dem zwischen dem ersten (122) und dem zweiten Gehäuse (128) gebildeten Hohlraum (121) angeordnet ist;

das Schraubenrad (112) einen sich axial erstreckenden Umfangsabschnitt mit einem ersten Durchmesser und einer darin ausgebildeten Verzahnung aufweist;

das Schraubenrad (112) entgegengesetzte, sich axial erstreckende Umfangsabschnitte mit einem zweiten, kleineren Durchmesser aufweist, die entsprechende Lagerflächen bilden;

die den zweiten, kleineren Durchmesser aufweisenden Lagerflächen des Schraubenrads (112) in der ersten Bohrung bzw. in der axial zu der ersten Bohrung versetzten und zu dieser koaxialen Bohrung angeordnet sind, um eine Radiallagerabstützung für das Schraubenrad (112) zu schaffen;

das Schraubenrad (112) eine sich radial erstreckende, eine zweite Ringfläche bildende Oberfläche aufweist, die zwischen den den ersten bzw. den zweiten Durchmesser aufweisenden Abschnitten des Schraubenrads (112) angeordnet ist und in Verbindung mit der ersten Ringfläche bewirkt, daß eine Axiallagerabstützung für das Schraubenrad (112) geschaffen wird;

das Schneckenrad (110) erste und zweite entgegengesetzte Endabschnitte, die zylindrische, koaxiale Lagerflächen bilden, und einen Zwischenabschnitt mit einem darin ausgebildeten Schneckengewinde aufweist;

der erste und der zweite Abschnitt in der zweiten Bohrung gelagert sind, um das Schneckengewinde zu der Verzahnung des Schraubenrads (112) auszurichten; und

eine Einrichtung vorgesehen ist, um den baulichen Zusammenhalt zwischen dem ersten (122) und dem zweiten Gehäuse (128) aufrechtzuerhalten und das erste Gehäuse (122) an dem zweiten Führungselement (16) zu befestigen.

3. Vorrichtung mit niedrigem vertikalen Profil zum Einstellen der horizontalen Sitzposition nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Mutter (102) an dem ersten Führungselement (18) durch einen baulichen Zusammenhalt zwischen der Mutter (102) und dem ersten Führungselement (18) befestigt ist.

4. Vorrichtung mit niedrigem vertikalen Profil zum Einstellen der horizontalen Sitzposition nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Schneckenrad (110), das erste und zweite entgegengesetzte Endabschnitte aufweist, welche zylindrische, koaxiale Lagerflächen bilden, durch kugelförmige Lagerteile (120) in der zweiten Bohrung gelagert ist.

Revendications

1. Mécanisme de réglage de position horizontale d'un siège à profil vertical bas utilisé pour permettre le réglage au choix de la position horizontale d'un siège de véhicule (10) par rapport à un socle (12) comprenant :

une paire d'éléments de glissières de guidage (16, 18) inverses l'un par rapport à l'autre et emboîtés l'un avec l'autre de manière coulissante pour former une section de tubulure ouverte (101) entre les deux ;
une première glissière de guidage (18) de ladite paire maintenue fixe et une seconde glissière de guidage (16) de ladite paire inverse par rapport à la première ;
une vis rotative orientée horizontalement (100) portée aux extrémités opposées par ladite seconde glissière de guidage (16) et disposée à l'intérieur de ladite section de la tubulure ouverte (101) ;
ladite vis (100) s'engageant par filetage avec un écrou (102) fixé à ladite première glissière de guidage (18) ;
une transmission (111) comportant un boîtier (122, 128) définissant une cavité (121) ;
une roue hélicoïdale (112) disposée à l'inté-

rieur dudit boîtier (122, 128) ;
une transmission à vis sans fin (110) disposée à l'intérieur de ladite cavité et engagée par engrenage avec la roue hélicoïdale (112) ; et
des moyens (114) permettant de connecter par entraînement ladite roue hélicoïdale (112) à ladite vis (100) ;

caractérisé en ce que

ladite transmission (111) est partiellement disposée à l'intérieur de ladite section de tubulure ouverte (101) formée entre lesdits éléments de glissières de guidage (16, 18) et
lesdits moyens permettant d'interconnecter par entraînement ladite roue hélicoïdale (112) et ladite vis (100) sont un câble flexible (114).

2. Mécanisme de réglage de position horizontale d'un siège à profil vertical selon la revendication 1, caractérisé en ce que :

ledit socle est formé par un soubassement fixé sur le sol (12) ;
ledit boîtier (122, 128) de ladite transmission (111) comprend un premier boîtier (122) qui définit une première moitié d'alésage et une seconde moitié d'alésage disposée perpendiculairement à ladite première moitié d'alésage, et un second boîtier (128) ayant une relation d'emboîtement structural avec ledit premier boîtier (122) définissant ladite cavité entre les deux ;
ledit second boîtier (128) définit une première moitié et une seconde moitié d'alésage qui interagissent avec les première et seconde moitiés d'alésages respectives dudit premier boîtier (122) pour former des premier et second alésages ;
lesdits premier et second alésages définissent des axes qui sont radialement décalés et orientés orthogonalement l'un par rapport à l'autre ;
ladite roue hélicoïdale (112) est disposée à l'intérieur de ladite cavité (121) définie entre lesdits premier et second boîtiers (128) ;
ladite roue hélicoïdale (112) comporte une partie circonférentielle d'un premier diamètre s'étendant axialement et comportant des dents ;
ladite roue hélicoïdale (112) comporte des parties circonférentielles opposées d'un second diamètre plus petit et définissant des surfaces portantes respectives ;
lesdites surfaces portantes d'un second diamètre plus petit de ladite roue hélicoïdale (112) sont disposées respectivement dans ledit premier alésage et ledit alésage décalé axialement du, et coaxial au, premier alésage pour fournir un support de palier radial à ladite roue hélicoïdale (112) ;
ladite roue hélicoïdale (112) comporte une surface s'étendant radialement et définissant une seconde face en forme d'anneau disposée entre les parties respectives de premier et second diamètres de ladite roue hélicoïdale (112) agissant conjointement avec ladite première face en forme d'anneau afin de fournir un support de palier axial à ladite roue hélicoïdale (112) ;
ladite transmission à vis sans fin (110) a des première et seconde parties d'extrémité opposées formant des surfaces portantes coaxiales et une partie intermédiaire ayant un filet de vis sans fin formé a l'intérieur ;
lesdites première et seconde parties sont soutenues par un support dans ledit second alésage pour permettre l'alignement dudit filet de vis sans fin avec lesdites dents de ladite roue hélicoïdale (112) ; et
des moyens pour maintenir ladite relation d'emboîtement structural entre lesdits premier (122) et second boîtiers (128) et fixer ledit premier boîtier (122) à ladite seconde glissière de guidage (16) sont fournis.

3. Mécanisme de réglage de position horizontale d'un siège à profil vertical selon la revendication 1 ou 2, caractérisé en ce que ledit écrou (102) est fixé à ladite première glissière de guidage (18) au moyen d'une relation d'emboîtement structural entre ledit écrou (102) et ladite première glissière de guidage (18).

4. Mécanisme de réglage de position horizontale d'un siège à profil vertical selon la revendication 1 ou 2, caractérisé en ce que ladite transmission à vis sans fin (110) ayant des première et seconde parties d'extrémité opposées formant des surfaces portantes coaxiales cylindriques est portée par des éléments de supports sphériques (120) dans le second alésage.

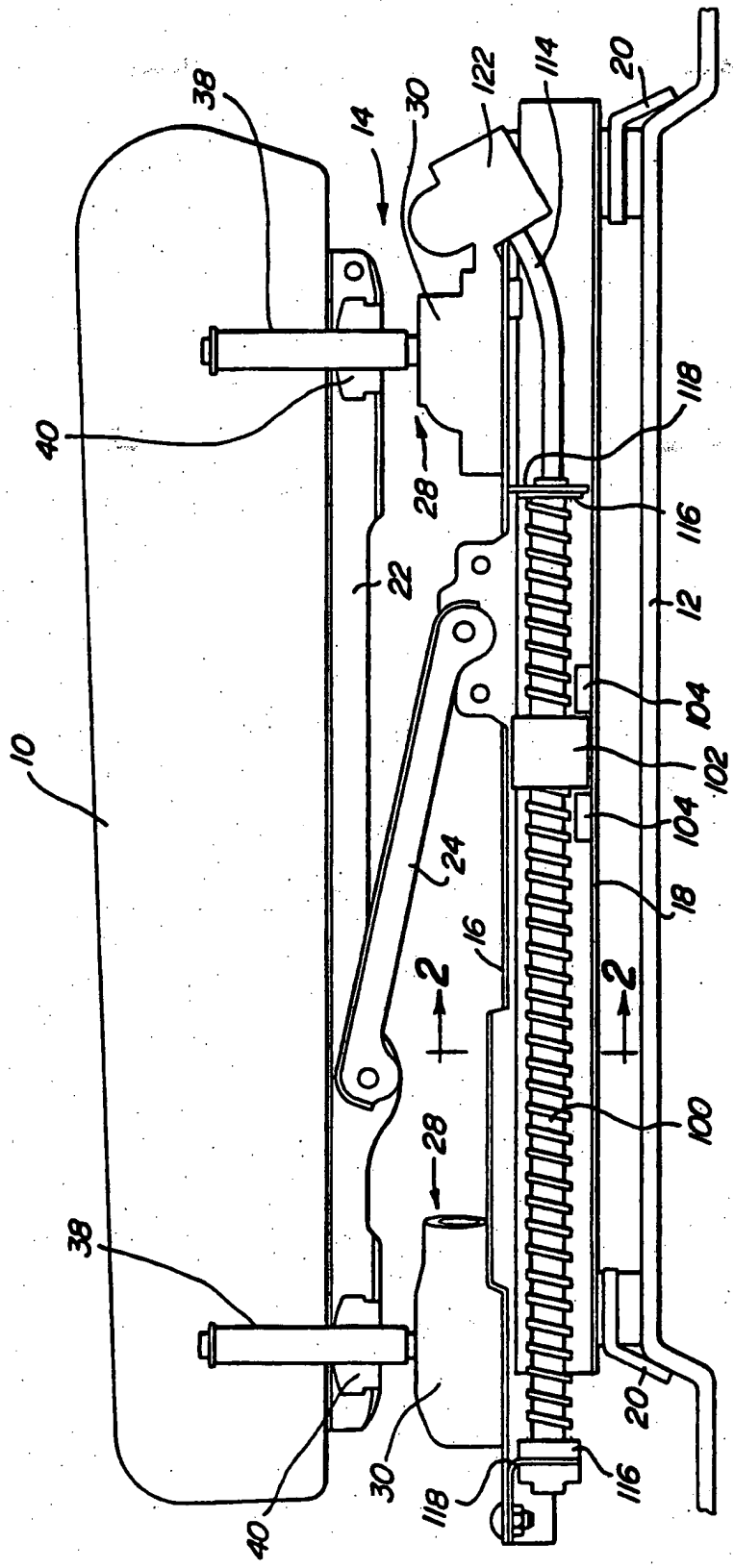
38
14
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Fig-1

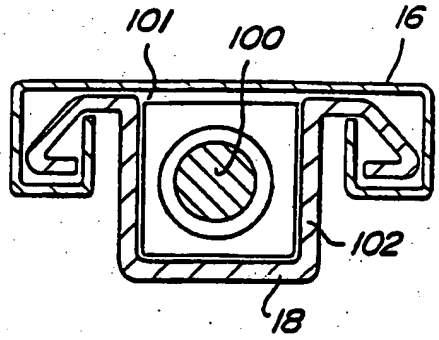


Fig-2

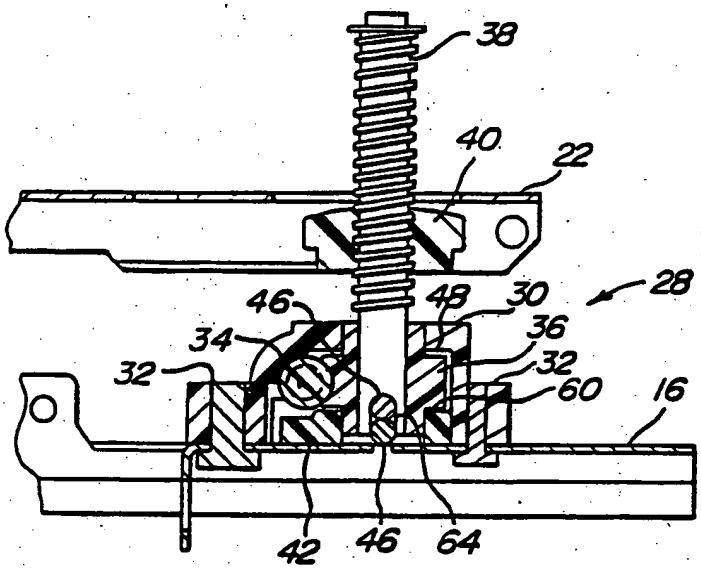


Fig-3

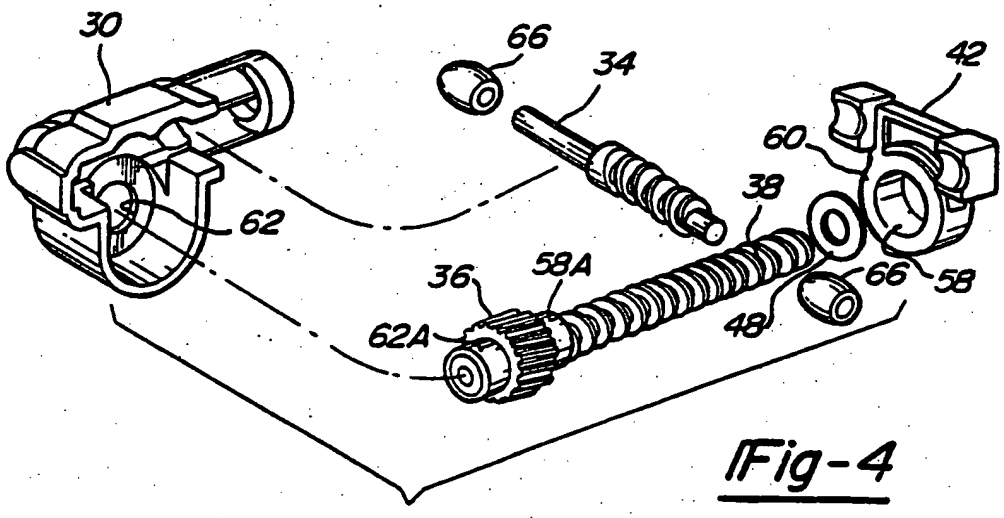


Fig-4

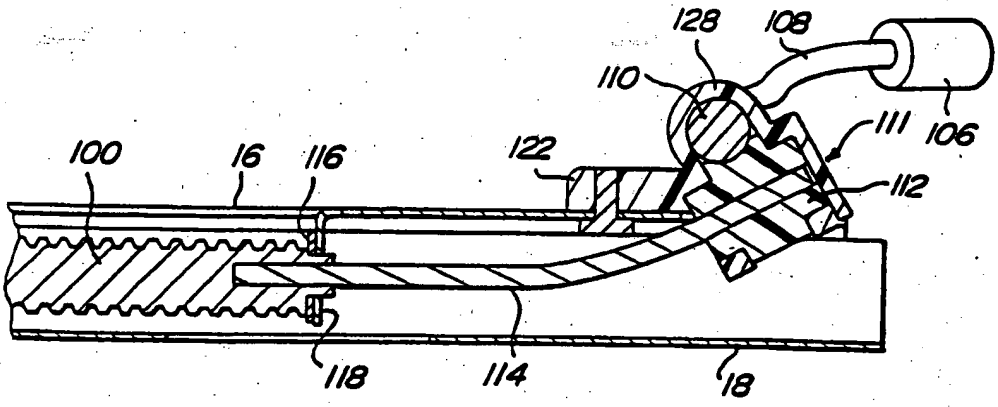


Fig-5

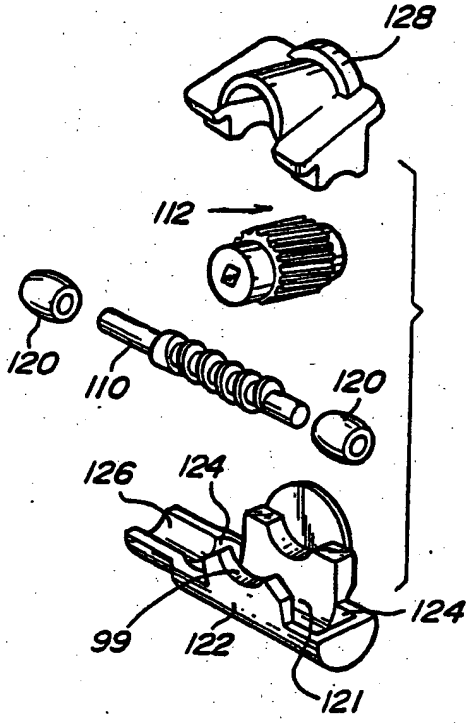


Fig-6

Fig-7

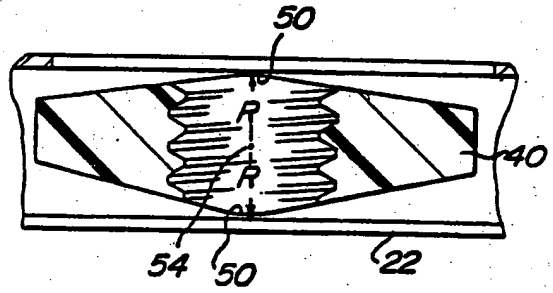
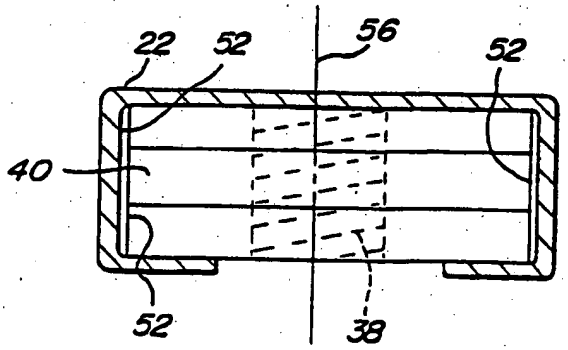


Fig-8



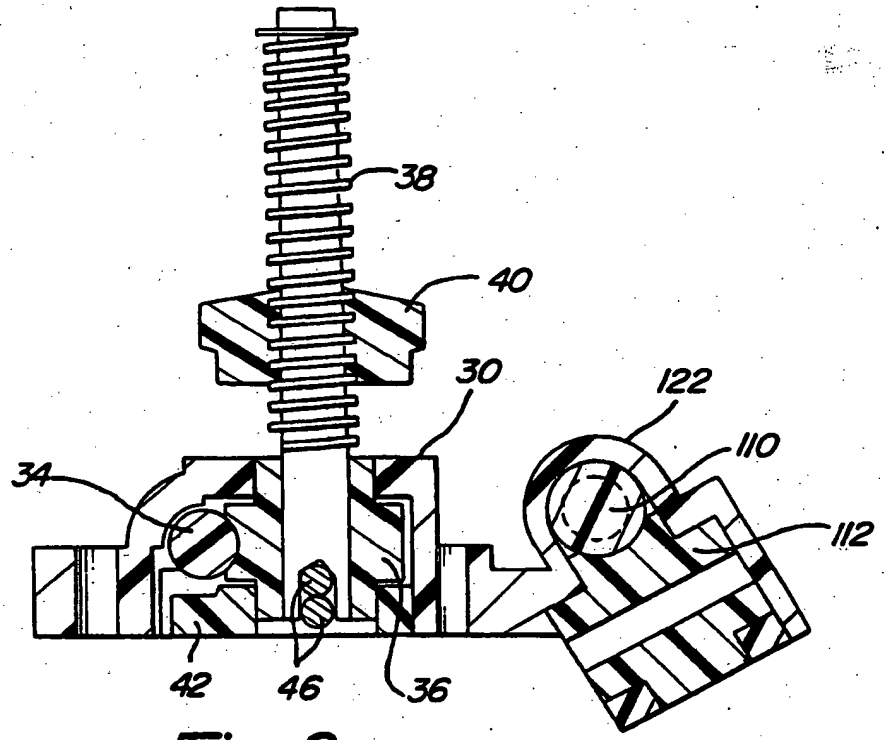


Fig-9